IMMORTALITY AND THE NEW PHYSICS

BY CHARLES KASSEL

THE leading obstacle until now in the way of any scientific thought of a future life has been the difficulty of conceiving a state of being such as it is necessary to assume—a state of being which demands a yielding of all our notions of matter. The mind aches in the effort to picture a plane of existence, unseen and unfelt, interpenetrating the material fabric about us, yet supplying a theatre for conscious life and activity. Even those convinced of the truth of psychic phenomena, and fully persuaded that the dead live again in a realm of their own, cannot build up in their thought a satisfying idea of that world in which the dead move and have their being. Life, love and memory as mere idealizations apart from form the mind rejects; yet form to us means matter, and matter, in our eyes, is something which must give to our senses evidence of its presence.

No merely philosophic answer to the eternal question fulfills the need. In this domain of thought, as in no other, we distrust the processes of abstract reason. Scorning all assumptions, we demand proof that a supersensual world of organized life is possible. This proof, so long denied, the science of to-day, with its startling revelations, is, as it might seem, about to vouchsafe, and it is with these new disclosures, and their relation to the world-old problem which so much perplexes us, that it is my purpose in this paper to deal.

As we looked abroad upon the universe a few years ago, we beheld a material fabric which seemed the most stable of things. Matter, we were taught in the books, was indestructible and ever-enduring, whatever its change of form—a something which in its constituent atoms had always been and could never cease to be; and conservation of mass was linked with the doctrine of inertia as the twin truths by which all reasoning as to the nature and destiny of the universe was conditioned.

It was idle to speak of an inner world, the arena of tremendous spiritual activities. The idea was brushed aside as wholly indefensible. Certain phenomena, it is true, even upon the natural plane, seemed to partake of the qualities ascribed by the mystics to this inner and higher sphere. There was electricity, defying time and space, and flashing around the world with the swiftness of thought, finding matter no obstacle in its path. There was gravitation, with no material embodiment that could be traced. There was light, traveling in a few seconds half the stretch of the ecliptic, yet borne to all seeming upon vacancy. These difficulties could not be gainsaid; but here was the rock-ribbed planet, our material seat, with the laws of inertia and conservation plainly stamped upon it, and it was but breath against the wind to talk of supersensual worlds interpenetrating this density and peopled by invisible beings who passed through this mass as though it were not.

"Show me," said the savant, "a single atom destroyed or built up—point to me a shred of proof worthy the consideration of a scientist that any element has ever been something other than it is to-day—do this and I shall give a respectful hearing to your claim of an upper world of being." The challenge could not be met.

In this hour, however, the challenge has been met. The discovery of radioactive matter—a fourth state of matter, neither gas, liquid nor solid—has humbled science before the mystics and has set our thinkers delving curiously and with a strange interest into the tomes of the alchemists. They were right, those old dreamers, and we with all our learning were wrong. Not even our soberest scientist now disdains to employ the language of Paracelsus and to speak of matter in all its varying modes as but the outflowering of a single universal element, the primal stuff of all substance, becoming visible and tangible out of the viewless seas of ether in some fashion we do not know.

With the opening up of these new vistas of the constitution of things, the bases for our whole thought of matter have shifted, and what seemed so appallingly fixed and resistant has grown fluent, yielding its opacity here to the ray of Röntgen, there its solidity to the Hertzian wave of Marconi, and yonder dissolving,

or changing magically to new forms, in the radioactive transformations of Curie and Becquerel, Rutherford and Soddy, Ramsey and Crookes. "It would be idle to deny," observes Professor Frederick Soddy, speaking of the phenomena of radioactivity in his fascinating work *The Interpretation of Radium*, "that physical science was taken completely by surprise. Had anyone twelve years ago ventured to predict radium, he would have been told simply that such a thing was not only wildly improbable but actually opposed to all the established principles of the science of matter and energy."

Says M. L. Poincaré, in *The New Physics*, referring to the latest theories: "We shall have to abandon the idea, so instinctively dear to us, that matter is the most stable thing in the universe, and to admit, on the contrary, that all bodies whatever are a kind of explosive decomposing with extreme slowness." And, similarly, Dr. R. K. Duncan, in his interesting work, *The New Knowledge*, observes: "Matter has disappeared as a fundamental existence, or at any rate it is explained as a manifestation of electricity. Mass, a supposedly indestructible thing, has disappeared with matter, and comes into existence purely as negative electricity, assuming motion, carries with it a bound portion of the ether in which it is bathed; and furthermore this mass, which we thought so invariable, depends solely upon the velocity with which the unit moves."

So, then, matter has become a transitory thing—the "Time-Vesture of the Eternal", in the sublime phrase of Carlyle. It is to the ether, that unseen, all-permeating thing, that we are driven henceforth to feed our love for the fixed and the lasting. We are told that through some stress upon the ether, in all likelihood, matter was born, perhaps as a mere mode of motion, rising out of its mother element as an ice crystal emerges from the sea, yet of it and destined in the fulness of time to return to it. It is this ether, which we have never beheld, which no instrument has ever explored, and which gives to our touch never a sign of its presence, that becomes the fundamental reality. "The whole mass of any body," says Professor J. J. Thomson, "is just the mass of the ether surrounding the body, which is carried along by the Faraday tubes associated with the atoms of the body. In fact, all

mass is mass of the ether; all momentum momentum of the ether; and all kinetic energy kinetic energy of the ether." To this statement, so startling in its implications, Sir Oliver Lodge, in THE NORTH AMERICAN REVIEW for May, 1908, lends his approval as the conclusion "which, in one form or another, we all see looming before us, though it has not yet been completely attained and would not be by all similarly expressed".

What, therefore, is the ether? Is it dense or rare? Does it possess motion or is it at rest? Shall we speak of it as simple or does it possess a structure? Will it yield to pressure like ordinary matter or is it incompressible?

Strange, indeed, are the properties that science ascribes to this mysterious element; quite as strange as the properties the old mystics assigned to the spiritual plane of being of which they told. "Although at first sight," says Professor Thomson, in his address before the British Association for the Advancement of Science,[1] "the idea that we are immersed in a medium almost infinitely denser than lead might seem inconceivable, it is not so if we remember that in all probability matter is composed mainly of holes. We may in fact regard matter as possessing a bird-cage kind of structure, in which the volume of the ether disturbed by the wires when the structure is moved is infinitesimal in comparison with the volume enclosed by them. If we do this there is no difficulty from the great density of the ether; all that we have to do is to increase the distance between the wires in proportion as we increase the density of the ether."

So, in a powerful discourse upon *The Functions of the Ether*, delivered at the Royal Institute of Great Britain on February 21, 1908, and published in the issue of THE NORTH AMERICAN REVIEW already mentioned, Sir Oliver Lodge, repeating the statement of Professor Thomson already quoted, observes: "This view, it should be said, requires the density of the ether to be immensely greater than any known substance—yes, far denser—so dense that matter by comparison is like gossamer or a filmy imperceptible mist, or a Milky Way;" and he adds: "The ether belongs to the material or physical universe; but it is not ordinary matter at all. I should prefer to say it is not matter at all. It

[1]Reprinted in *Science* for August 27, 1909.

may be the substance or substratum or material of which matter is composed." Similar is the idea of M. Poincaré, as given in the work from which I have already quoted: "We cannot," he tells us, "without being very illogical, define the ether by material properties."

Where, then, are we, in this amazing speculation, vouched for though it be by our greatest thinkers? Let us pause to consult our compass and take our bearings, for it is a measureless sea we have embarked upon, and we must take heed that we do not drift too far and lose our sense of the relations of things.

If we reject the idea that spiritual forms are of a substance transcending the ether in its properties, and suppose Intelligence, with an organism answering in its characteristics merely to the properties of the ether, we have a being conforming very nearly, if not quite, to the notion the mystics had of the indwellers of the supersensual world. With bodies more dense than steel, though unamenable to earthly sight or touch, these creatures would see the fleshly forms as a shadowy garment, and matter at large but as a film thinner than air which offered no bar to their passage, and, exempt from the laws of gravitation, which hold prison-bound the frame of clay, they might levitate at will, and with the swiftness of light transport themselves from planet to planet. From the sun's flame they could take no harm and even the chill of absolute zero would leave their bodies unscathed.

Such a conception, indeed, might have been harbored even before the revelations of the past few years. No less an authority of the earlier day than J. Clerk Maxwell recognized the fascinating interest of such a theory. In concluding the article upon *The Ether of Space* contributed by him, while Professor of Physics at Cambridge University, to *The Encyclopedia Britannica*, this distinguished scientist said: "Whether this homogeneous expanse of isotropic matter is fitted not only to be a medium of physical interaction, and to fulfill other physical functions of which perhaps we have no knowledge, but also, as the authors of *The Unseen Universe* seem to suggest, to constitute the material organisms of beings exercising functions of life and mind as high or higher than ours at present, is a question far transcending the limits of physical speculation."

But how explain upon such a theory, it may be urged, the use of this body by an indwelling Intelligence—how link reflection and love and memory with so strange an organism? In the abstract, the difficulty does seem insurmountable; the mind cannot grasp the laws by which a governing Will within could utilize the organs of such an instrument. But, in the abstract, the difficulty is no whit less on the lower material plane; it is only our familiarity with the actual phenomena that makes it seem otherwise. Who knows how it is that the mind, as we are familiar with it, moves at its will the fingers of the hand? This—our familiarity with the phenomena aside—is a veritable miracle. We are as ignorant of its final cause as we are of the primary cause of electricity, or as we are ignorant of gravitation in its first cause, or of heat, or light, or even of the thing that makes a seed grow. These things *are*, despite our inability to understand them, and it is no strain upon the reason to suppose that the like may be true with bodies of ether, or of some higher, more transcendent substance which surpasses the ether in its properties and uses it as we use the electric and magnetic forces that lie in nature.

All this, however, might well have been taught in the middle age of modern science, before the wizardry of Röntgen and the Curies and their successors had made science gasp. It is with the marvels of the last few years that the picture we have sought to sketch of the supersensual world becomes complete and convincing.

It is a singular truth, and one highly significant, that the more nearly science in its triumphs over nature has approached that unseen world, the more powerful have been the forces that revealed themselves. It is of no small importance that the most tremendous of these energies should seem to come from a region of the universe hidden from the senses, and identical, to all seeming, with the ideal world of being taught by the mystical philosophers of all ages.

In the dim beginning, man's sole resource was his muscular energy and that of his subject beasts, aided by gravitation and the simpler laws of mechanics. But our muscular power roots purely in the material, and upon the same plane operate the laws of mechanics. The like is true even of steam, since vapor was

always familiar to man, although its immense power under pressure was not suspected. It was with the discovery and utilization of electricity that science seemed to pierce beyond the material into a new universe. Here was a force apparently inexhaustible, coming seemingly from nowhere, and the nature of which defied all conjecture and analysis. The savants found themselves baffled in every attempt to explain the phenomena of electricity in terms of matter.

But though it could not dissect this energy, so new and strange, and could only learn its laws and yield to them, science, it seems safe to say, believed this mysterious force to be the last that remained for discovery. Sir William Crookes, perhaps, alone excepted, no scientist appears to have felt the tremendous truth just dawning upon the world—the truth that we had but touched the fringe of the inner world of energy, out of which electricity and perhaps many other of our known forces play as from perennial fountains, and that still farther within were resources of power beside which steam and electricity were mere toys.

It is difficult to form an adequate idea of the power of these new forces coming seemingly from beyond the material. All our former notions of energy seem humdrum and commonplace by comparison. "There is enough radiant energy in one ounce of radium," said Dr. Duncan, in an article in *Harper's Magazine*, "to lift ten thousand tons one mile high;" and he added by way of explanation: "During the life of radium it evolves nearly three million times as much heat proportionately as arises from any chemical action known to man. This is a tremendous fact, determined by strict experiment and quite apart from any theory." So, Gustave Le Bon, the eminent French philosopher and scientist, asserted in an article in *The Independent* that "the fifth part of an American five cent piece, if we could entirely disassociate it in one second, would give an energy equal to six milliards, eight hundred million horse-power, the energy of a moving body being equal to half the product of its mass by the square of its velocity."

These statements, wildly extravagant though they seem, are not the mere fancies of a few enthusiasts drunken with the wine of the new lore. They are the calm assertions of sober scientists.

Professor J. J. Thomson, writing in *Science*, remarked: "The amount of energy which is stored up in ordinary matter in the form of electrostatic potential energy of its corpuscles is the thing not generally realized. Even ordinary matter contains enormous stores of energy; this energy is fortunately kept fast bound by the corpuscles; if at any time an appreciable fraction were to get free the earth would explode and become a gaseous nebula." So, Sir Oliver Lodge, speaking of the ether as the source of this energy: "On our present view the energy of the constitution of the ether is incredibly and portentously great; every cubic millimeter of space possessing what, if it were matter, would be a mass of a thousand tons and an energy equivalent to the output of a million horse power station for forty million years."

To understand the new physics rightly requires almost a new set of brain cells. We must learn to think in infinitesimals linked with velocities approaching that of light. We are dealing with what is to us well-nigh the infinitely great, associated with the infinitely little, and we are forced in carrying forward our train of thought to drive a-team ideas never before yoked together.

We are told that the spectroscope will discover in a thimbleful of air the existence of a single particle of neon, co-existing with four million particles of other gases, and that this inconceivably tiny particle contains no less than ten million millions of atoms. The idea of minuteness involved in such a statement is sufficiently staggering; yet we know now that the atom is not the smallest thing in nature, and that it is the electron within the atom which must stand before our thought as the unit of matter. So unimaginably small, however, is this newer particle, that its diameter, as we are told by Professor Millikan in *The Popular Science Monthly*, is only about 100,000th that of the atom; and according to Sir Oliver Lodge, the electron, as compared with the atom, is "that of the earth and other planets to the solar system", or, as Professor J. J. Thomson has it, that of a dust particle to the entire volume of air in a lecture-hall.

It is in its velocity that the enormous power of the ultra-atomic particle resides. We know what velocity will do on the material plane. A flexible chain, swiftly twirled, will stand on end; a silk cord becomes rigid in rapid motion; a jet of water moving at

sufficient speed resists a hammer stroke; while a paper disk, we are told, if it could be made to perform the necessary number of revolutions per second, would act like a buzz-saw. It is a commonplace that the vortex of a tornado will uproot a giant oak or break its trunk like a reed, lift a building into the air and crush it like an eggshell, or carry heavy masses for many miles; and now and then stories reach the newspapers of straws hurled like spears into trees, and wooden billets driven like so many spikes into brick or stone walls. These aspects of matter in motion may enable us the more clearly to understand the actual power of the radioactive particle and the theoretical power of the electron in general.

Within the atom, now become a very miracle of complexity, the electrons revolve with incredible swiftness about a common centre, much as in our solar system the sun's satellites sweep about the central orb, with the orbits and spaces no greater in the latter case than in the former, relatively to size. "The motion and change of motion of the electrons," says Professor Soddy, "gives us light, the X-rays, and the long ether-waves used in wireless telegraphy," and the reaction of the ether upon the moving electron, he explains, gives it its "mass".

Now and then, we are told, a particle escapes from the atomic system, as in the case of the radioactive substances, and it becomes possible to measure its momentum. The *alpha* particles, says Professor Soddy, reach in some cases a speed of twelve thousand miles per second, while the fastest of the *beta* particles of radium attain as high a speed as 170,000 miles per second, approaching that of light itself. Le Bon, in an article already referred to in this paper, asserts that a velocity of 60,000 miles per second for certain of the radiations has been measured, and in order that the significance of the figure may be appreciated, the distinguished French scientist explains that to give a speed of 60,000 miles per second to a rifle ball would require an arm holding 1,340,000 barrels of powder each weighing over one hundred pounds! Such are the phenomena which have revolutionized all thinking and driven science to a conception of the atom of matter as a dynamic thing—a reservoir of "supra-terrific forces", in the daring phrase of Dr. Duncan.

Now momentum, according to the fundamental doctrine of dynamics, is never born, but only borrowed. No body in nature ever moves of itself. It is pushed or drawn. As observed by Professor J. J. Thomson in *Science*, "the amount of momentum in the universe is constant," and wherever, therefore, any substance manifests momentum, that momentum comes from beyond itself. The relation of this truth to the new physics is dealt with by Professor Soddy in the series of lectures to which I have referred. "The last century," he observes, "will remain forever memorable on account of the development and establishment of the great doctrine of energy. The first law, that of the conservation of energy, states that energy is a real entity and has a real existence no less than matter, and no more than matter can energy be created or destroyed, although the forms it may assume are legion. The driving power of the machinery of the modern world is often mysterious, but the laws of energy state that nothing goes by itself, and our experience, in spite of all perpetual motion machines which inventors have claimed to have constructed, bore this doctrine out until we came face to face with radium. Nothing goes by itself in Nature, except, apparently, radium and radioactive substances."

Such being the language of the science of dynamics and the universal pronouncement of our thinkers and investigators, the conclusion drives in irresistibly upon us that the energy of the radium particle, whether within the atom or after its expulsion, falls within the general law, and that its terrific power is a something borrowed from an inner, unexplored, inconceivably complex realm, beside which this lesser arena of activity inhabited by us is the tamest of worlds.

It will not do to say that in the radioactive substances we have an exception to a law which the whole science of energetics hitherto has shown to be universal. The need for making such an exception does not exist, and it is far more logical to say of this new form of energy that *it comes from somewhere.* This conclusion seems only the more reasonable when we learn that the *alpha* particles of radium cease beyond a certain range of space to give token of their presence, possessing at the moment of their disappearance "sixty-four per cent of their initial velocity", as

stated by Dr. Duncan, and "forty-one per cent of their initial kinetic energy"; for the implication is plain that through ordinary matter as well may be pouring vast tides of energy, only at velocities too low to affect the most delicate of our instruments—less, say, than five thousand miles per second.

That in the radium rays we have an indication of a new and mysterious world of energy, we find what seems an impressive testimony in the law of velocity governing these in common with other recently discovered phenomena. "One definite thing we do know," says Professor Soddy, writing of the ether, "namely, the velocity at which influences are transmitted. It is 185,000 miles per second, the speed of light. So far as we yet know, all influences that are transmitted by the ether travel at this one definite velocity. Not only light, but also the electro-magnetic radiations employed in wireless telegraphy, the magnetic storms, as they are termed, which reach us from the sun, and also as we believe, the X-rays, travel through the ether at this one definite speed." That the speed is in all these cases the same is suggestive of a common source and fountain-head, and one is emboldened in the supposition that behind and within the material system with which we are familiar is a subtle and infinitely marvelous world from which the universe we know is fed and sustained, and which uses the light—swift undulations of the ether—as the carrying agent of its varied influences.

Taking together all that we have here considered, one may claim abundant warrant for the statement that the attitude of science toward the notion of a supersensual universe, or series of universes, interacting with the material fabric we know—a concept fundamental to any logical theory of immortality—has ceased to be the hostile or indifferent one it once was. On the contrary, it might almost seem that the theory of a universe of finer and infinitely more potent substance is almost ready to be announced by our scientific thinkers as an inevitable conclusion from recent discoveries. It is a thing of illimitable portent that the atom, the very starting point of the universal fabric, which we should have expected to find of utmost simplicity, science actually discovers to be a mechanism of unimaginable complexity; nor shall our conclusion be easily challenged that this baffling and

unbelievably complex thing may be the link with another world of being, whence the life and energy of the world we know are borrowed for a season.

I cannot better close this paper than by quoting the nobly prophetic words of Sir William Crookes, delivered more than thirty years ago, concerning the new matter of which at that time the first faint hint had appeared: "We have actually touched the borderland where matter and energy seem to merge into one another—the shadowy realm between the known and the unknown;" and it seems almost as if by an inspiration that this most intuitive of our scientists should have been able to say in that hour: "I venture to think the greatest scientific problems of the future will find their solution in this borderland, and even beyond. Here, it seems to me, lie ultimate realities—subtle, far-reaching, wonderful."

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